

ABSTRACT

4H-InGaAlN alloy based optoelectronic and electronic devices on non-polar face are formed on 4H-AlN or 4H-AlGaN on (11-20) a-face 4H-SiC substrates. Typically, non polar 4H-AlN is grown on 4H-SiC (11-20) by molecular beam epitaxy (MBE). Subsequently, III-V
5 nitride device layers are grown by metal organic chemical vapor deposition (MOCVD) with 4H-polytype for all of the layers. The non-polar device does not contain any built-in electric field due to the spontaneous and piezoelectric polarization. The optoelectronic devices on the non-polar face exhibits higher emission efficiency with shorter emission wavelength because the electrons and holes are not spatially separated in the quantum well. Vertical device
10 configuration for lasers and light emitting diodes(LEDs) using conductive 4H-AlGaN interlayer on conductive 4H-SiC substrates makes the chip size and series resistance smaller. The elimination of such electric field also improves the performance of high speed and high power transistors. The details of the epitaxial growth s and the processing procedures for the non-polar III-V nitride devices on the non-polar SiC substrates are also disclosed.